

STATUS REPORT

The Influence of Global Convection on Region-1 Birkeland Current Structure
Year-2

February 1, 1993 - January 31, 1994

NASA Grant NAGW-2856 ✓

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The major efforts during Year-2 have dealt with the fundamental description of field-aligned currents in MHD plasmas and both theoretical and empirical analysis of currents in Earth's plasma-sheet boundary layer (PSBL).

A conceptual model of the PSBL was formed and assumed to explain and model precipitation and electric field patterns observed at low-altitude from the DE-2 and DMSP-F9 satellites when crossing the poleward boundary of the evening auroral zone. It is suggested that the pair of oppositely directed field-aligned currents spaced in latitude result within the PSBL owing to different rates of earthward drift of electrons and protons in the magnetotail current sheet comprising a Hall generator. Details of observed ionospheric electric fields were reproduced assuming this generator and ionospheric conductivity gradients observed near the polar-cap boundary. Copies of the two papers by Burke et al. which report these results are included with this report, and these findings were reported at several scientific meetings during this past year.

In collaboration among this PI, Mike Heinemann and Duane Pontius, the fundamental description of field-aligned current generation in MHD plasma has been generalized to include inertial effects. For the first time, the role of the perpendicular vorticity has been revealed to lead to polarization of the plasma and parallel electric fields in magnetospheric plasma, even when in steady state and isotropically distributed in pitch angle. This finding has important implications to our understanding of parallel currents and fields in the low-latitude and plasma-sheet boundary layers, and possibly in the inner-edge region of the plasma sheet. Expressions have been formulated which will be of future use in numerical modeling of the solar-wind-magnetosphere-ionosphere coupled system. The detailed mathematical and physical description has been accepted for publication in *Journal of Geophysical Research*. A preprint accompanies this report. A more physical discussion of parallel electric fields in isotropic plasma, without the mathematical complexities, is in revision for publication in *Geophysical Research Letters*. This physical description will be presented by this PI at the next Spring AGU Meeting.

Work performed by the Co-I reported in last year's report involving electric and magnetic field fluctuations at high latitude in the dayside ionosphere has been presented at various scientific gatherings including last summer's GEM meeting. Also contained in last year's report was work by the PI comparing DMSP data to predictions of the field-aligned current

(NASA-CR-197623) THE INFLUENCE OF
GLOBAL CONVECTION ON REGION-1 BI
RKELAND CURRENT STRUCTURE, YEAR-2
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Jan. 1994 (Boston Univ.) 3 p

N95-70856

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and precipitation patterns in the nightside auroral zone. The predicted patterns are based on earlier work performed in collaboration with Dick Wolf using the Rice Convection Model (RCM). Results of this work have been reported at various seminars and the Spring AGU Meeting this past year. The paper "The Physics of the Harang Discontinuity, 2. Consequences of Dawnside Depletion" has been revised for publication in *Journal of Geophysical Research*, but the referees still have some suggestions which need to be addressed. The knowledge we have been gaining concerning the physics of M-I coupled convection in Earth's magnetosphere was incorporated in an invited paper given at the last GEM meeting on magnetospheric substorm theories. A reprint of the report is enclosed.

Publication Summary:

Burke, W. J., J. S. Machuzak, N. C. Maynard, E. M. Basinska, G. M. Erickson, R. A. Hoffman, J. A. Slavin, and W. B. Hanson, Auroral Signatures of the Plasma Sheet Boundary Layer in the Evening Sector, *J. Geophys. Res.*, 99, 2489-2499, 1994. (Reprint enclosed.)

Egeland, A., W. J. Burke, N. C. Maynard, E. M. Basinska, J. D. Winningham, and C. S. Deehr, Ground and Satellite Observations of Postdawn Aurorae Near the Time of a Sudden Storm Commencement, *J. Geophys. Res.*, 99, 2095-2108, 1994. (Reprint enclosed.)

Erickson, G. M., Substorm Theories: Are They Converging, in *Report on the GEM Workshop on the Physics of the Tail and Substorms, Snowmass, Colorado, 1-2 July, 1993*. (Reprint enclosed.)

Basinska, E. M., W. J. Burke, N. C. Maynard, W., J. Hughes, D. J. Knudsen, and J. A. Slavin, Electric and Magnetic Field Fluctuations at High Latitudes in the Dayside Ionosphere, in *Proceedings of the Chapman Conference on Solar-Wind Sources of Magnetospheric ULF Waves, Williamsburg, VA, 14-18 September 1992*, in press. (Preprint last report.)

Burke, W. J., J. S. Machuzak, N. C. Maynard, E. M. Basinska, G. M. Erickson, R. A. Hoffman, J. A. Slavin, and W. B. Hanson, Electrodynamical Signatures of the Plasma Sheet Boundary Layer in the Evening Ionosphere, in *Physical Signatures of Magnetospheric Boundary Layer Processes*, edited by A. Egeland, J. A. Holtet, and P. E. Sandholt, Kluwer Academic Press, in press. (Preprint enclosed.)

Erickson, G. M., R. W. Spiro, and R. A. Wolf, The Harang Discontinuity and Magnetospheric Forecasting, *Proceedings of the Solar-Terrestrial Predictions Workshop, Ottawa, 18-22 May 1992*, in press. (Preprint last report.)

Heinemann, M., G. M. Erickson, and D. H. Pontius, Jr., Inertial Currents in Isotropic Plasma, *J. Geophys. Res.*, in press. (Preprint enclosed.)

Erickson, G. M., The Physics of the Harang Discontinuity, 2. Consequences of Dawnside Depletion, *J. Geophys. Res.*, revised. (Preprint last report.)

Heinemann M., D. H. Pontius Jr., and G. M. Erickson, Parallel Electric Fields in Isotropic Plasma, *Geophys. Res. Lett.*, revised.

Presentations:

Erickson, G. M., The Physics of the Harang Discontinuity, Consequences of Dawnside Depletion, Phillips Laboratory, Space Physics Division, 29 March 1993.

Erickson, G. M., The Physics of the Harang Discontinuity, Consequences of Dawnside Depletion, Boston University, Center for Space Physics, 1 April 1993.

Basinska, E. M., Low-Frequency Electric and Magnetic Field Fluctuations at High Latitudes in the Dayside Ionosphere, Phillips Laboratory, Space Physics Division, April 1993.

Basinska, E. M., Low-Frequency Electric and Magnetic Field Fluctuations at High Latitudes in the Dayside Ionosphere, University of Maryland, April 1993.

Burke, W. J., N. C. Maynard, J. S. Machuzak, E. M. Basinska, G. M. Erickson, R. A. Hoffman, and J. A. Slavin, Signatures of the Plasma Sheet Boundary Layer in the Evening Sector, (Invited), NATO Advanced Research Workshop: Physical Signatures of Magnetospheric Boundary Layer Processes, Oslo, Norway, 9–14 May 1993.

Burke, W. J., J. S. Machuzak, N. C. Maynard, E. M. Basinska, G. M. Erickson, R. A. Hoffman, and J. A. Slavin, Electrodynamic Signatures of the Plasma Sheet Boundary Layer in the High-Latitude Ionosphere (N. C. Maynard), AGU Spring Meeting, Baltimore, 24–28 May 1993.

Erickson, G. M., Field-Aligned Current Structure Within the Harang Discontinuity Sector, AGU Spring Meeting, Baltimore, 24–28 May 1993.

Basinska, E. M., W. J. Burke, N. C. Maynard, W. J. Hughes, D. J. Knudsen, and J. A. Slavin, Electric and Magnetic Field Fluctuations at High Latitudes in the Dayside Ionosphere with Southward IMF, GEM Workshop, Snowmass, Colorado, 30 June 1993.

Erickson, G. M., Substorm Theories: Are They Converging?, (Invited) GEM Workshop on the Physics of the Tail and Substorms, Snowmass, Colorado, 1 July 1993.

Erickson, G. M., and S. Stahara, Coupled Magnetosheath-Magnetosphere Model, GEM Working Group 5 Meeting, Boston College, 26–27 October, 1993.

Hau, L.-N., and G. M. Erickson, Penetrations of the IMF B_y Into Earth's Plasma Sheet (Poster, G. M. Erickson), AGU Fall Meeting, San Francisco, 6–10 December, 1993.

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Annual Performance Report
NASA-Ames Cooperative Agreement Number NCC 2-662

Modeling Atmospheric Scatterers Using Spacecraft Observations

For the period February 1, 1994 through January 31, 1995.

(NASA-CR-197857) MODELING
ATMOSPHERIC SCATTERERS USING
SPACECRAFT OBSERVATIONS Annual
Performance Report, 1 Feb. 1994 -
31 Jan. 1995 (Space Physics
Research Inst.) 8 p

N95-70858

Unclass

29/46 0042630

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